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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/845,526	04/25/97	PAPAKIPOS	M SGI-15-4-453

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LM02/0910

EXAMINER

PADMANABHAN, M

ART UNIT

PAPER NUMBER

2772

DATE MAILED:

09/10/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.
08/845,526

Applicant(s)
Papakipos et al.

Examiner
Mano Padmanabhan

Group Art Unit
2772



☒ Responsive to communication(s) filed on Jun 28, 1999

☒ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) 1, 2, 5-9, and 11-25 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1, 2, 5-9, and 11-25 is/are rejected.

☒ Claim(s) 17 is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been
☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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DETAILED ACTION

Status of claims

Claims 1-2, 5-9, 11-25 are in the Application.

Claims 4, 5, and 10 have been cancelled.

Claims 1-2, 5-9, 11-25 are rejected.

Claim 17 is objected to.

Response to Amendment

Applicants response and amendments of 6/28/99 have been fully considered.

Claim Rejections - 35 USC § 102

Response to Amendments: The amendments have overcome this rejection.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 17 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

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Claim 17 adds to claim 16 the limitation of “evaluating the plurality of Bezier control points”. This limitation is implied in step “a” of amended claim 16, since generating a plurality of surface partials would imply evaluating the Bezier control points input to the interpolator. Hence it appears that claim 17 is already contained in claim 16, unless the claim 17 is citing a repetition of step 16a, in which case there is a lack of descriptive support in the specification.

Claim Objections

Response to Amendments: The amendments have overcome the objections cited in the last office action.

3. Claim 17 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Claim 17 adds to claim 16 the limitation of “evaluating the plurality of Bezier control points”. This limitation is implied in step “a” of amended claim 16, since generating a plurality of surface partials would imply evaluating the Bezier control points input to the interpolator. Hence it appears that claim 17 is already contained in claim 16, unless the claim 17 is citing a repetition of step 16a, in which case there is a lack of descriptive support in the specification.

Claim Rejections - 35 USC § 103

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Applicants amendments to the claims to overcome the 35 USC 102 and 35 USC 103 rejections made in the previous office action has necessitated the following new rejections.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

4. Claims 1-2, 5, 6, 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), **Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847).**

In the amended Claim 1, the applicant lays claim to a computer system that implements the method of receiving a NURBS model from a server, converting it to a Bezier model, generate a plurality of control points on the Bezier curve **from a plurality of NURBS control points using a tri-linear interpolator in the graphics pipeline**, and rendering the curve using the graphics pipeline.

Jia et al teach a method of converting a NURBS surface model to a Bezier surface model, evaluating a plurality of NURBS control points into Bezier control points (**Col.3: lines 32-37**, Col. 4: lines 38-45), and interpolating a plurality of control points (Col. 5: lines 1-5). *Jia et al* fail to teach the use of tri-linear interpolator, and a method to receive the data from the server (host processor) and rendering it. *Gharachorloo et al* teach a method to receive data from a host

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processor into a graphics pipeline, and use the graphics pipeline to render the object (refer Figs. 1, 2, 2A). **Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22).** Hence it would be obvious to one skilled in the art at the time the invention was made to store the surface model data in a host processor, and use this method to download the data as needed, **and use a tri-linear interpolator to generate the Bezier control points from NURBS control points as this would ensure better utilization of system processing resources on the client, and provide high speed and accuracy and enable velocity control to a given tolerance.**

Claim 2 adds to claim 1 the step of receiving the NURBS surface model via the bus.

Gharachorloo et al teach a method to receive data using a bus (refer Fig. 1). Hence it would be obvious to one skilled in the art at the time the invention was made to use a bus to receive the NURBS model from a host processor, as it is an effective and dependable communication medium.

Claim 6 adds to claim 1 the limitation of generating points on the curve using Bezier control points.

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Jia et al disclose the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44).

Claim 8 adds to claim 1 the use of graphics rendering pipeline to render the curve or surface.

Gharachorloo teaches the use of a Graphics pipeline (Fig. 1). Hence it would be obvious to one skilled in the art at the time the invention was made to use a graphics pipeline to render the curve as this would streamline the process, and accelerate the process of rendering the curve.

Amended Claim 5 adds to claim 1 the limitation of the use of NURBS control points as input to the tri-linear interpolator, and evaluating these points to generate Bezier control points.

Jia teaches the method of evaluating a plurality of NURBS control points into Bezier control points (Col.4: lines 38-44). Jia fails to teach the use of tri-linear interpolator, and the input of NURBS control points to the tri-linear interpolator. Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it is obvious to one skilled in the art at the time the invention was made to use a tri-linear interpolator

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to generate the Bezier control points since this will provide high speed and accuracy, **and enable velocity control to a given tolerance.**

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), **Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847) as applied to claim 6, and further in view of Sherman et al. (U.S. Patent 5,734,756).**

Claim 7 adds to claim 6 the limitation that the Bezier control points are input to a tri-linear interpolator to generate points on the curve.

Jia et al disclose the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44). Jia et al also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Jia et al fail to disclose the use of tri-linear interpolator. Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Sherman et al teach that Bezier curves are generally evaluated using a recursive algorithm due to de Casteljau (Col.14: lines 32-35). Since Bezier curve is a special case of a NURBS curve, it would be obvious to one skilled in the art at the time the invention was made to

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input the Bezier control points to a tri-linear interpolator to generate points on the curve, as this would improve system performance.

6. Claims 9, 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Luken, Jr.* (U.S. Patent Number 5,278,948), *in view of Jia et al.* (U.S. Patent Number 5,726,896) and *Sherman et al* (U.S. Patent Number 5,734,756).

Amended Claim 9 lays claim to a method of rendering curves by evaluating a Bezier curve using de Casteljau process **using a tri-linear interpolator** in the graphics rendering pipeline.

Luken teaches the use of Cox-DeBoor (or DeCasteljau) process for evaluating a b-spline curve (Col.15: lines 40-44). Luken also teaches the method of using a graphics pipeline (Col.28: lines 59-61), and the use of Cox-DeBoor process in the graphics processor for evaluation (Col.29: lines 5-10). **Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators.** Luken fails to teach the use of these methods for a Bezier curve. Jia et al also teach that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Sherman discloses that the de Casteljau process is a widely accepted method of evaluating Bezier curves (Col. 14: lines 32-35). Hence it would be obvious

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to one skilled in the art at the time the invention was made to use the de Casteljau process, and a **tri-linear interpolator** in the graphics pipeline to evaluate and render a Bezier curve, since this would render the system faster.

Claim 11 adds to claim 9 the limitation that the Bezier control points are input to a tri-linear interpolator to generate points on the curve.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Luken fails to disclose the use of Bezier control points as input to these interpolator. Jia discloses the use of Bezier control points as input to the processor that determines points on the curve (Col.3: lines 32-44). Jia also teaches that the Bezier curve is a special case of the B-spline curve (Col.7: line 27). Sherman et al teach that Bezier curves are generally evaluated using a recursive algorithm due to de Casteljau (Col.14: lines 32-35). Since Bezier curve is a special case of a NURBS curve, it would be obvious to one skilled in the art at the time the invention was made to input the Bezier control points to a tri-linear interpolator to generate points on the curve, as this would improve system performance.

Claim 12 adds to claim 11 the limitation of using the plurality of points to render the Bezier curve.

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Luken discloses a method of using the points derived by evaluating a b-spline to render a surface (Col.27: lines 11-21). Since Bezier is a special case of a B-spline curve (Jia: Col. 7: line 27), it would be obvious to one skilled in the art at the time the invention was made to use of Bezier control points during evaluation to render a Bezier curve, as this would involve the least amount of operations on the part of the graphics processor.

7. Claims 13 - 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Jia et al.* (U.S. Patent Number 5,726,896) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), **Luken, Jr. (U.S. Patent Number 5,278,948), and Schulmeiss (U.S. Patent Number 5,717,847)..**

Amended claim 13 lays claim to a graphics rendering pipeline of a computer system that evaluates the NURBS control points to a Bezier model **using a tri-linear interpolator in the graphics pipeline**, generates a plurality of control points on the Bezier curve, and renders the curve.

Jia et al teach a method of loading a processor with the NURBS control points (Col.3: lines 32-36), converting the NURBS surface model to a Bezier surface model (Col. 4: lines 38-48), and determining a plurality of points on the Bezier curve. *Jia et al* fail to teach a method of rendering the curve using a graphics pipeline. *Gharachorloo et al* teach a method of using the graphics pipeline to render NURBS surfaces (Col.9: lines 64-67). **Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear**

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interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators.

Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it would be obvious to one skilled in the art at the time the invention was made to use a graphics pipeline to render the Bezier curve using the points derived by using the method as described by Jia, as this would streamline the rendering process, and ensure better utilization of system processing resources, **and provide better control over velocity levels.**

Claim 14 adds to claim 13 the limitation of using a tri-linear interpolator to evaluate the NURBS control points into Bezier control points.

Jia teaches the method of evaluating a plurality of NURBS control points into Bezier control points. Jia fails to teach the use of tri-linear interpolator, and the input of NURBS control points to the tri-linear interpolator. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators. Hence it is obvious to one skilled in the art at the time the invention was made to use a tri-linear interpolator to generate the Bezier control points since this will provide high speed and accuracy.

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Claim 15 adds to claim 13 the step of transforming the NURBS curve or surface from a global domain to a local domain.

Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27). Hence it is obvious to one skilled in the art at the time the invention was made to use global to local transformation of the NURBS curve, as such a transformation can make better utilization of the available resources.

8. Claims 16-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,278,948) as applied to claim 16, in view of *Jia et al.* (U.S. Patent Number 5,726,896) and Schulmeiss (U.S. Patent Number 5,717,847).

Amended claim 16 lays claim to a method of generating normal vectors for a surface based on generating surface partials **using a tri-linear interpolator loaded with Bezier control points as input**, then generating surface tangents from these partials, and generating normals from these tangents.

Claim 17 adds to claim 16 the limitation of using a tri-linear interpolator to evaluate the Bezier control points, and generate surface partials.

Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to

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these interpolators. Luken also teaches the use of interpolators for each component to derive the surface partials (Col. 19: lines 18-25). Luken fails to teach the use of Bezier control points as input to the tri-linear interpolator. Jia teaches the method of evaluating Bezier control points (line 35-40). Jia also teaches that Bezier curve is a special case of a B-spline curve. Schulmeiss discloses the use of de Casteljau algorithm to calculate Bezier control points (Col. 2: lines 16-22). Hence it is obvious to one skilled in the art at the time the invention was made to use Bezier control points as input to a tri-linear interpolator to generate surface partials, since Bezier points are a subset of NURBS control points.

Claim 18 adds to claim 16 the step of generating the surface tangents from the surface partials using a blender in the graphics pipeline.

Luken teaches the generation of surface tangents from surface partials for NURBS surfaces (Col.9: lines 6-25). Luken fails to teach this for blending curves. Jia teaches that the Bezier curves are a special case of B-splines, and also teaches the use of Bezier curves as blending functions (Col. 7: lines 29-31). Hence it is obvious to one skilled in the art at the time the invention was made to use such blending curves, since the shape approximation with NURBS is not generally understood, and the NURBS can be exactly represented by a series of piecewise Bezier curves.

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Claim 19 adds to claim 18 the step of generating at least one normal from the surface tangents.

Luken teaches the method of generating normals from surface tangents ((Col.9: lines 6-25).

9. Claims 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684).

Amended claim 20 lays claim to a method of rendering a curve by doing a global to local transformation, evaluating the NURBS control points **using tri-linear interpolation**, and rendering the curve using the points thus created.

Luken teaches a method of evaluating NURBS control points to derive points on the curve (Col.15: lines 40-45). **Luken inherently teaches the use of tri-linear interpolators by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45), the NURBS control points forming the input to these interpolators.** Luken fails to teach a transformation from global domain to local domain. Gharachorloo teaches a method of transforming the NURBS surface model from a global memory to local memory (Col.2: line 58 - Col.3: line 10 & Col.14: lines 17-27), rendering a NURBS curve. Hence it would be obvious to

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one skilled in the art at the time the invention was made to use the transformation as taught by Gharachorloo so as to make better utilization of the local resources.

Claim 21 adds to claim 20 the step of indexing at least one look up table for performing the transformation.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics control processor (Col.12: lines 18-20).

Claim 22 adds to claim 21 the limitation of evaluating the NURBS control points using tri-linear interpolator.

Luken inherently teaches the use of tri-linear interpolators for evaluating the NURBS control points, by disclosing that the de Casteljau process performs a linear interpolation between the components (x,y,z) of the control points (Col.4: lines 40-54; Col. 15: lines 32-45).

Claim 23 adds to claim 22 the limitation of indexing the look up table to be able to configure the tri-linear interpolator.

Luken teaches the use of transformation matrix pre-loaded in memory in the graphics control processor (Col.12: lines 15-20), which is used to transform the x, y, z coordinates of the control points.

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Claim 24 adds to claim 23 the step of implementing a quadri-linear interpolator using tri-linear interpolator, and generating control points.

Luken discloses the existence of NURBS control points with coordinates (wx,wy,wz,w), and the evaluation of such control points by interpolation (Col.15: lines 32-46). This inherently teaches quadri-linear interpolation.

10. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Luken, Jr. (U.S. Patent Number 5,728,948) in view of *Gharachorloo et al* (U.S. Patent Number 5,488,684), and further in view of Oha (U.S. Patent Number 5,202,670).

Claim 25 adds to claim 20 the use of convolution in the graphics pipeline to obtain points on the curve.

Oha teaches the convolution of original data and interpolated function in the graphics pipeline to derive a set of points on the curve (Col.15: lines 5-13). Hence it is obvious to one skilled in the art at the time the invention was made to use convolution in order to achieve faster processing of the control points.

Response to Arguments

Applicant's arguments with respect to claim 1 have been considered but are moot in view of the new ground(s) of rejection.

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Luken discloses a system that decomposes a NURBS surface into rational Bezier patches for further processing (Col.1: lines 45-50). Luken teaches that the DeCasteljau process employed for evaluation performs a linear interpolation between the components (the x, y, and z components - hence, tri-linear) of the control points. Hence the arguments that Luken does not teach evaluation of NURBS surfaces directly without any conversion to Bezier surfaces, and tri-linear interpolation is not persuasive

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Conclusion

Any response to this correspondence should be mailed to:

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or faxed to:

(703) 305-9051, (for formal communications; please mark "EXPEDITED
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Or:

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"PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2021 Crystal
Drive, Arlington, VA., Sixth Floor (Receptionist).

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mano Padmanabhan whose telephone number is (703) 306-2903. She can normally be reached Monday-Thursday from 6:30am-5:00pm.


If attempts to reach the examiner are unsuccessful, the examiner's supervisor, Mark Powell, can be reached on (703) 305-9703.

Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

MP

Mano Padmanabhan

August 30, 1999



MARK K. ZIMMERMAN
PRIMARY EXAMINER